Curiosity Guide #310
Electric Batteries

Accompanies Curious Crew, Season 3, Episode 10 (#310)

Electric Lemon

Investigation #2

Description

Lemons can make more than lemonade! They can become batteries!

Materials

- 4 lemons
- Kitchen knife
- 4 pennies
- 4 zinc galvanized nails
- 6 alligator clip cables
- LED light
- Voltmeter

Procedure

1) Use the knife to make a small slit in the side of each lemon so that part of a penny can fit snugly.
2) Slide a single penny into each slit so that half of the penny is sticking out of the lemon.
3) On the opposite side from each penny, insert a galvanized nail halfway into the lemon. The nail should not touch the penny inside the lemon.
4) Connect the lemons with 4 alligator clip cables so that the penny in one lemon connects to the nail in another lemon, and so on.
5) Clip the final 2 alligator clip cables onto the remaining penny and nail so that each clip has one free end.

6) Connect the two loose clip cables to the wires on the LED light.
7) Did the light turn on?
8) You can test the voltage of each lemon by touching the meter ends on the penny and nail.
9) Try squeezing one of the lemons. Did squeezing the lemon make a difference in the meter's reading?

My Results

Explanation

Batteries are used to change chemical energy into electrical energy through a redistribution of electrons between different metals and a solution. Every battery has three components: an electrolyte and two types of electrodes-- an anode, and a cathode.

The electrolyte is a liquid or gel-like substance that connects the two different metals, providing a path for electrons to move from one metal to the next and creating a chemical reaction. The anode and cathode each connect to an opposite end of the battery. At these points of contact, there is a chemical reaction. The anode loses electrons and the cathode receives them. Because the two metals have

different voltages, the electrons move from the concentrated negative terminal, or anode, toward the lower concentrated positive terminal, or cathode. Placing a device that requires electrons, like an LED, between the anode and the cathode makes the light turn on.

In this case, the copper-plated penny and the galvanized zinc nail are the electrodes. The citric acid in the lemon is the electrolyte. The electrical current flows from the copper penny, through the acid, to the nail, and eventually continues through the LED light, which requires about 1.7 volts. Squeezing a lemon breaks up some of the inside lemon and increases the flow of current. Repositioning the penny or nail may also help adjust the current.

Something to investigate: Find a drawing of an atom in a book or on the internet. Then think about this: Making a light turn on requires electricity, but what is electricity? Well, all things are made up of atoms, teeny tiny things that look a little like our sun, with planets orbiting around them. The center of every atom is called the nucleus, which holds protons and neutrons, while electrons are free to spin around the nucleus. The electrons have a negative charge and are attracted to the positive charge of the protons. When electrons move, we have electricity! Those electrons can travel along a closed path or circuit and make things turn on, even a little LED light!

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